The Gamete of Pediatric Vascular Surgery: One Surgeon’s Experience

Georgia Vascular Society
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Ritz-Carlton Reynolds, Lake Oconee
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Nothing to disclose
Challenges of Pediatric Vascular Surgery

- Lack of training and experience
- Technical challenge
- Proper instrumentation, equipment and support staff
- Conduit choice
- Pre and post operative care
Pediatric vessels

- Size
- Limited ability to perform embolectomy
- Spasm
- Fragile
- Clamps
Anastomosis

- Spatulated
- Interrupted vs running
- Permanent vs absorbable suture
- Compensate for growth in diameter and length
Conduit

- Synthetic
- Venous
- Arterial
Arkansas experience

- Congenital/Cancer
- Trauma
Upper extremity trauma

- 3 y/o M with supracondylar fracture and dusky hand
- 4 y/o M with absent radial pulse after closed reduction of supracondylar fracture
- Exploration of the brachial artery finding kinking of the artery
- Release of the adventia resulted in a pulse
- Both doing well post op
Insights gained

- Brachial artery can become entrapped in children
- Release is sufficient
Upper extremity trauma

- 10 y/o M with L brachial artery laceration
- 13 y/o M, ATV accident, open humerus fracture with brachial artery transection
- Repaired with GSV interposition graft
- Pulse at last check with good limb growth
Insights gained

- Don’t fear the small size of the artery
- Use 7-0 and 8-0 permanent suture
- Running suture has been successful
- Use GSV for arm, leave back wall intact, leave room for growth, anticipate spasm
Lower extremity trauma

- 11 and 7 y/o F with traumatic common femoral artery injury
- 13 y/o F with tibial fx after pinned between tailgate and tree, popliteal artery injury
- Two 13 y/o with post knee dislocation and popliteal injury
Lower extremity trauma

- All repaired with interposition GSV graft and running suture
- Fasciotomy, intra op angiogram
- Followed with duplex – no secondary procedures required up to 10 years
- All with pulses currently and no limb length discrepancy
Lower extremity trauma

- 7 y/o M, traumatic avf of pop artery from BB
- Repaired with excision of fistula and repair of artery and vein with GSV patch
- Doing well with palpable pulse, no edema
Insights gained

- Excellent patency with GSV
- GSV is adequate for common femoral
- Valve lysis not possible due to size
- Anticipate spasm
- Very low threshold for fasciotomy
Neck trauma

- 6 y/o M sustained injury to neck after a TV fell on him
- ICA found to be injured, initially followed then repaired due to increasing stenosis
- Internal iliac harvested and used for conduit
Insights gained

- Use internal iliac for short bypasses such as in the carotid
- Many small veins surrounding the artery
- No shunt needed
Popliteal entrapment

- 10 y/o M presented with cool left leg, discolored toes, leg pain
- Thrombosed left pop art
- MRI found to have bilateral entrapment
- Left interposition graft with GSV
- Right release of entrapment
- Doing well post op with palpable pulses
Popliteal entrapment

- 15 y/o M Acute thrombosis after 3 months of symptoms
- Lysis, thrombectomy, patching, bypass, 9 hour – eventually BKA
- Contralateral entrapment release
Leg ischemia

- 15 y/p presented with 3 wk hx of leg pain, claudication and lack of pedal pulse in RLE
- CTA showed multiple sites of occlusion
MRI

- Right leg positive for type I entrapment
- Left leg normal
Blood work

- Heterozygous for prothrombin g2021a mutation
Angiogram with attempted lysis

Multilevel occlusions with
Distal PT patent
Lysis unsuccessful

Taken to OR
Atempted fogarty (#2)
SFA to PT bypass with GSV
Lower Extremity Arterial Ankle/Brachial Pressures
(Duplex results on bottom of page)

2/26/2018

Impression: Normal bilateral ankle/brachial indices of R=1.06, L=1.04. Normal bilateral great toe pressures.

Ankle/Brachial Resting Pressures (mmHg)

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td>Arm</td>
<td>130</td>
<td>134</td>
</tr>
<tr>
<td>Ankle</td>
<td>142</td>
<td>139</td>
</tr>
<tr>
<td>Toe</td>
<td>87</td>
<td>83</td>
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<tr>
<td>Ankle/Arm Indices</td>
<td>1.06</td>
<td>1.04</td>
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Ankle Pressures(mmHg) and Doppler Waveforms:

<table>
<thead>
<tr>
<th>Dorsalis Pedis</th>
<th>Right</th>
<th>Left</th>
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</thead>
<tbody>
<tr>
<td>Ankle Pressure</td>
<td>134</td>
<td>135</td>
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<tr>
<td>Doppler Waveform</td>
<td>Normal</td>
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<table>
<thead>
<tr>
<th>Posterior Tibial</th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td>Ankle Pressure</td>
<td>142</td>
<td>139</td>
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<tr>
<td>Doppler Waveform</td>
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</tbody>
</table>
Insight gained

- Claudication in children does happen – look for causes
- Entrapment can be bilateral
- Use medial incision for bypass, post approach for muscle release
- Leg bypass with GSV is durable and very effective
Aortic trauma

- 12 y/o M gun shot wound to aorta at the level of the renal arteries
- Aorta replaced with deep vein with supra renal clamp
- Did well post op
Mycotic pseudoaneurysm

- 15 y/o male underwent kidney transplant
- 9 days later developed hypotension, hematoma around kidney
- Explored, kidney was thrombosed, iliac artery was damaged and replaced with 6 mm PTFE
Mycotic psuedoaneursym

- 3 months later presented with abd pain, fever and claudication in LLE
Pre-Op CTA
Pre-Op CTA
Operative repair

- Opening of psuedoaneursym, removal of infected PTFE
- Ileo fem bypass with deep fem vein
# Post-Op ABI

**Lower Extremity Arterial Ankle/Brachial Pressures**

3/22/2018

**Impression:** Continues to have normal ABI's and toe pressures.

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<thead>
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<td>Arm</td>
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<td>126</td>
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<tr>
<td>Toe</td>
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<tr>
<td>Ankle/Arm Indices</td>
<td>1.02</td>
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**Ankle Pressures (mmHg) and Doppler Waveforms:**

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<td>Doppler Waveform</td>
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**Digit PPG Waveforms**

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<tr>
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<th>Right</th>
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<tbody>
<tr>
<td>1</td>
<td>Present</td>
<td>Present</td>
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</table>
Insight gained

• Deep vein excellent conduit for aorta and iliac artery without morbidity
• Extensive venous complex over aorta
Median Arcuate ligament syndrome

- 13 y/o female presents to GI clinic with complaints of abdominal pain, nausea, reflux and constipation
- Post prandial pain
- Food fear
- Wt lose
Pre-Op CTA
Pre-Op CTA
Operative repair

• GSV was harvested, aortic punch used to created arteriotomy, aorta to celiac bypass performed, 7-0 prolene
Post-Op CTA
Post-Op CTA
Post-Op CTA
Post-Op duplex

Visceral Artery Duplex Exam

4/24/2018


<table>
<thead>
<tr>
<th>Aorta (cm/sec)</th>
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<tbody>
<tr>
<td>Proximal</td>
<td>217</td>
</tr>
<tr>
<td>Mid</td>
<td>160</td>
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<tr>
<td>Distal</td>
<td>182</td>
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<table>
<thead>
<tr>
<th>Aorta-Celiac axis bypass graft (cm/sec)</th>
<th></th>
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<tbody>
<tr>
<td>Origin</td>
<td>PSV=298  EDV=44</td>
</tr>
<tr>
<td>Proximal</td>
<td>PSV=257  EDV=44</td>
</tr>
<tr>
<td>Mid</td>
<td>PSV=160  EDV=26</td>
</tr>
<tr>
<td>Distal</td>
<td>PSV=156  EDV=34</td>
</tr>
<tr>
<td>Celiac</td>
<td>PSV=91   EDV=25</td>
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</table>

<table>
<thead>
<tr>
<th>Hepatic A (cm/sec)</th>
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<tbody>
<tr>
<td></td>
<td>PSV=92</td>
</tr>
</tbody>
</table>
Post op course

- Eating normally
- Normal activity
- Gaining wt
Median arcuate ligament

- 14 y/o F with post prandial pain and wt lose
- Reimplantation of celiac into aorta
- Doing very well post-op both clinically and by duplex
Insights gained

• Very rewarding results in my series
• Clear off all fibrous tissue
• Celiac artery has a peculiar angle at its trifurcation – construct bypass accordingly
Aortic stenosis

- 13 y/o involved in MVC at age 3 with seat belt injury and bowel resection
- Presented with claudication
- Loud bruit and thrill
- U/S showed aortic stenosis
- ABI at rest 0.92 and 0.98 with abnormal exercise ABI
Pre-Op CTA
Pre-Op CTA
Operative repair

- Aorta was opened and web removed
- Closed with pericardial patch
Post operative course

- Complete resolution of his symptoms
Insight gained

- Venous complex over aorta
- Try to preserve all lumbar arteries
- Bovine pericardial patch is effective
- Leave room for growth
Dialysis Access

- 12 y/o male with ESRD
- AVF placed in the wrist 10/2017
- Started to fail
- Fistulogram showed large side branches
Pre-Op angiogram

collateral draining into the basilic vein
Operative course

• Arm was explored and large side branches were identified visually and by angiogram, these were ligated
Intra-Op angiogram
Dialysis access

- 8 other patients underwent access procedures
- Most radiocephalic fistulas
- One groin graft
- Typical revisions
Insights gained

• Very small size, proceed with good success

• Same basic principles as in adults
Renal vascular hypertension

• 16 y/o male with uncontrolled HTN, multiple meds, diastolic greater than 100
Pre-Op CTA
Post-Op CTA
Post operative course

• Off all meds
• Doing well
• Graft is patent without stenosis
Renal vascular hypertension

- 11 y/o M with uncontrolled HTN underwent right renal artery bypass with GSV
- Did well for 5 years, found to have thrombosed bypass
Renal vascular hypertension

- 9 y/o M with uncontrolled HTN
- Right renal artery bypass with right internal iliac
- Thrombosed after 1 month
Retroperitoneal tumor

- 8 y/o F found to be very hypertensive
- CT showed large retroperitoneal mass encasing the aorta, celiac axis, SMA, and renal 8.8x7.5x5.6 cm
- Extrinsic compression of visceral vessels
Pre-Op CTA
Operative course

- Thoracoabdominal incision
- PTFE sewn end to side to distal aorta above the bifurcation with 2 “wing” GSV grafts
- Bilateral renal arteries sewn to these wings
- Proximal aortic anastomosis was constructed in the chest
- Tumor resected
Operative course

• Deep vein harvested and used for conduit bypass from PTFE to SMA
• Completion of case stable and making urine
Post op course

- Acidosis, re-explored and SMA bypass thrombosed
- Eventually died due to bowel ischemia
Insight gained

- Spectrum of technical failure
**Mid Aortic Syndrome**

- 2 year 6 month, 13 Kg F presented with flu like symptoms

- **Echo revealed severe LV dysfunction**, discharged on oral heart failure meds

- Eventually had end organ dysfunction and placed on a Berlin LVAD, multiple pressors and intubated and listed as 1A for heart transplant
Mid Aortic Syndrome

- Upper ext/ lower ext pulse and blood pressure difference identified and angiogram was obtained
Operative Repair

• Berlin LVAD replaced with Centrifugal pump
• Supra-celiac clamp placed and aortic bypass graft constructed, end to side, 7-0 prolene
• Left renal transposed and re-implanted to distal aorta, 8-0 prolene
• Right internal iliac harvested and used for conduit as interposition graft from aorta to right renal art, 8-0 prolene
Post Operatively

- Weaned from pressors and LVAD
- Extubated
- Tolerating regular diet
- Mild narrowing of renals, still with mod failure and one antihypertensive med
- Off transplant list
- Running into vascular lab
Pediatric vascular surgery

• While not very common there is a wide gamete of pediatric vascular pathology that may present
• Using some basic principles much can be accomplished in this challenging but very rewarding arena
Acknowledgments

- Dr. Cheney Wilson
Thank you
Thyroid tumor

- 14 y/o s/p thyroidectomy several years prior
- Presented with mass directly behind innominate artery
- Sternotomy with resection of mass
Literature

- Most are case reports
- Series describing renal vascular hypertension
- Recent review of 30 years in a tertiary hospital presented 130 cases
Vascular Specialist International


<table>
<thead>
<tr>
<th>Diagnosis (n)</th>
<th>Operation (n)</th>
</tr>
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<tbody>
<tr>
<td>Aorto-iliac Aneurysm (4)</td>
<td>Endoaneurysmal graft replacement (3)</td>
</tr>
<tr>
<td></td>
<td>Excision &amp; primary repair (1)</td>
</tr>
<tr>
<td>Renovascular hypertension (21)</td>
<td>Bypass (11)</td>
</tr>
<tr>
<td></td>
<td>Autotransplantation (6)</td>
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<tr>
<td></td>
<td>Nephrectomy (3)</td>
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<tr>
<td></td>
<td>Reimplanatation of renal artery (1)</td>
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<tr>
<td>Acute arterial occlusion (3)</td>
<td>Image-guided thrombectomy (2)</td>
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<tr>
<td></td>
<td>Mechanical thrombectomy (1)</td>
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<tr>
<td>Chronic arterial occlusion (2)</td>
<td>Vein bypass (1)</td>
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<tr>
<td></td>
<td>Myotomy &amp; vein bypass (1)</td>
</tr>
<tr>
<td>Portal hypertension (20)</td>
<td>Distal splenorenal shunt (18)</td>
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<tr>
<td></td>
<td>Mesocaval shunt (1)</td>
</tr>
<tr>
<td></td>
<td>Stent (1)</td>
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<tr>
<td>Glycogen storage disease (13)</td>
<td>Portocaval shunt (13)</td>
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<tr>
<td>Varicose vein (7)</td>
<td>High ligation &amp; stripping (7)</td>
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<tr>
<td>IVC thrombosis due to tumor (4)</td>
<td>Thrombectomy (3)</td>
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<tr>
<td></td>
<td>Inferior vena cava excision &amp; interposition graft (1)</td>
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<tr>
<td>Trauma (5)</td>
<td>Primary repair/bypass (5)</td>
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<tr>
<td>End stage renal disease (52)</td>
<td>Autologous arterio-venous fistula (52)</td>
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</table>
**Post-Op duplex**

**Aorto-Iliac Duplex**

3/22/2018

**Impression:** Mid-distal aorta is patent with no evidence of stenosis. Left ileo-fem vein graft is patent with no evidence of stenosis.

**Aorto-iliac arteries**

<table>
<thead>
<tr>
<th>cm/sec</th>
<th>MID</th>
<th>DISTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aorta</td>
<td>111</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LT ILEO-FEM VEIN GRAFT</th>
<th>PRX ANAST</th>
<th>MID</th>
<th>DISTAL ANASTAMOSIS</th>
<th>CFA</th>
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<tbody>
<tr>
<td>L Iliac Artery</td>
<td>121</td>
<td>53</td>
<td>58</td>
<td>87</td>
</tr>
</tbody>
</table>

**Comment:** Rt and Lt CFA acceleration times in normal limits. See today's ABI report.

**Technical Quality:** Adequate